

Energy Storage Valuation and Modeling

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Renewables and Grid Management**

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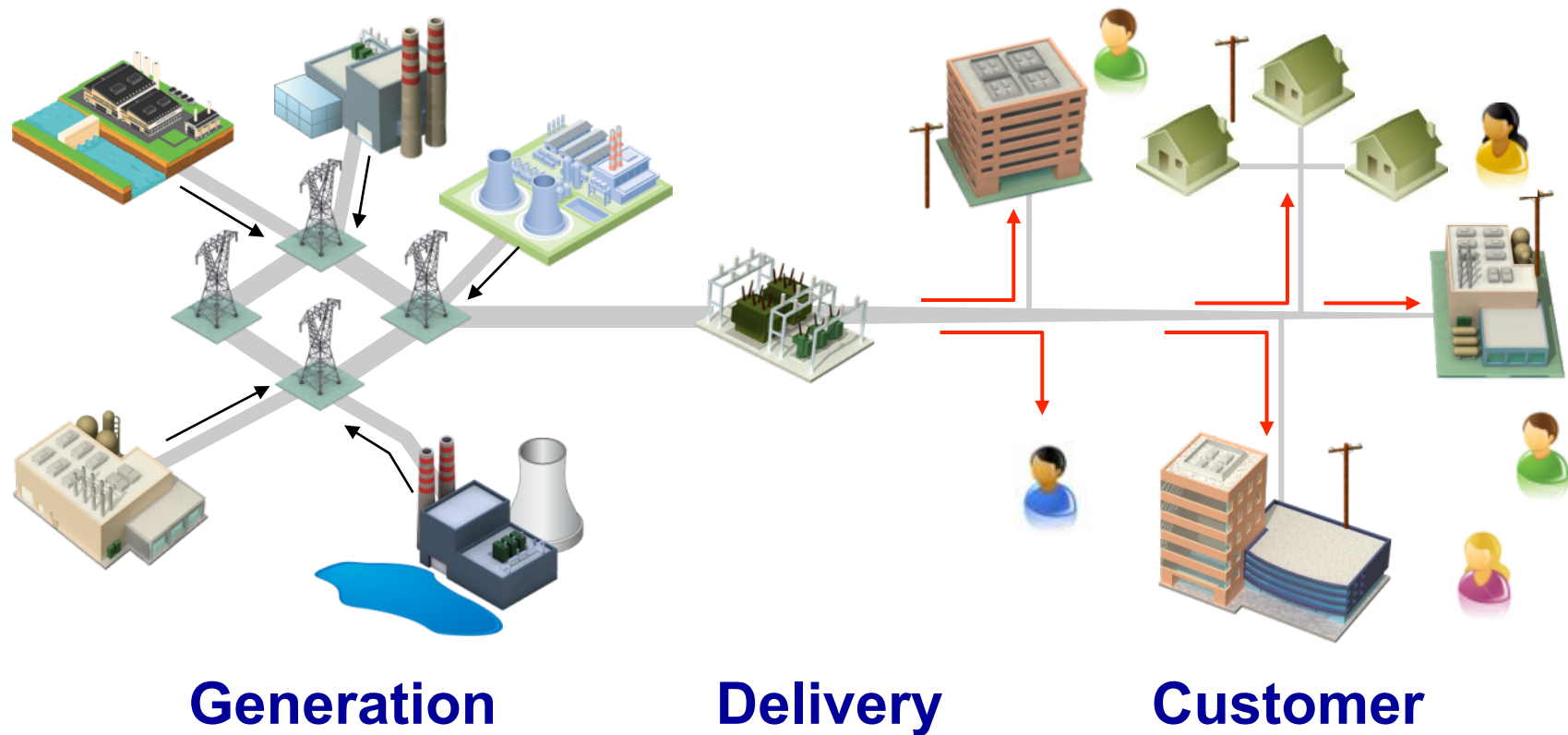
Together...Shaping the Future of Electricity

EPRI's Mission

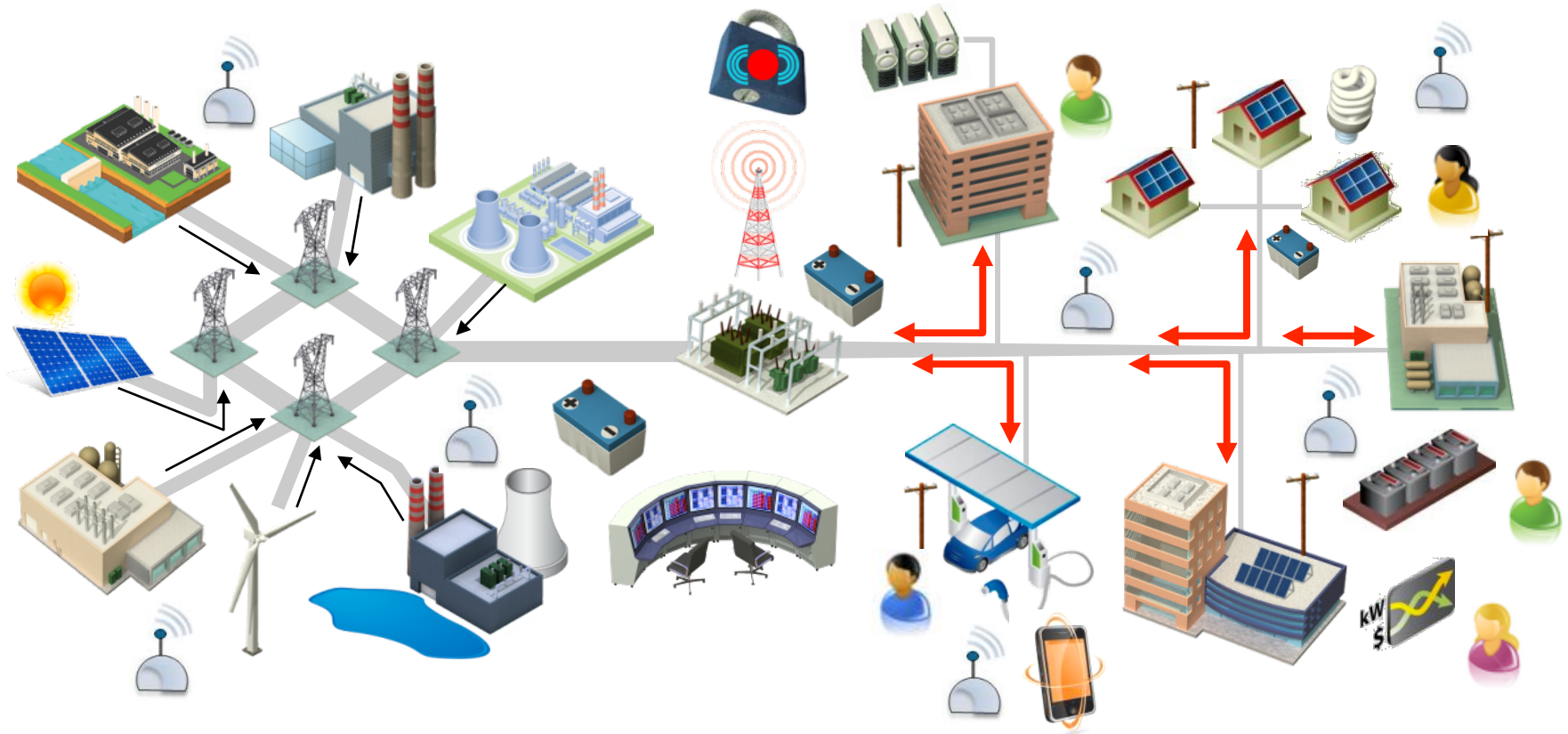
Advancing safe, reliable, affordable, and environmentally responsible electricity for society through global collaboration, thought leadership and science & technology innovation.



Today's Power System

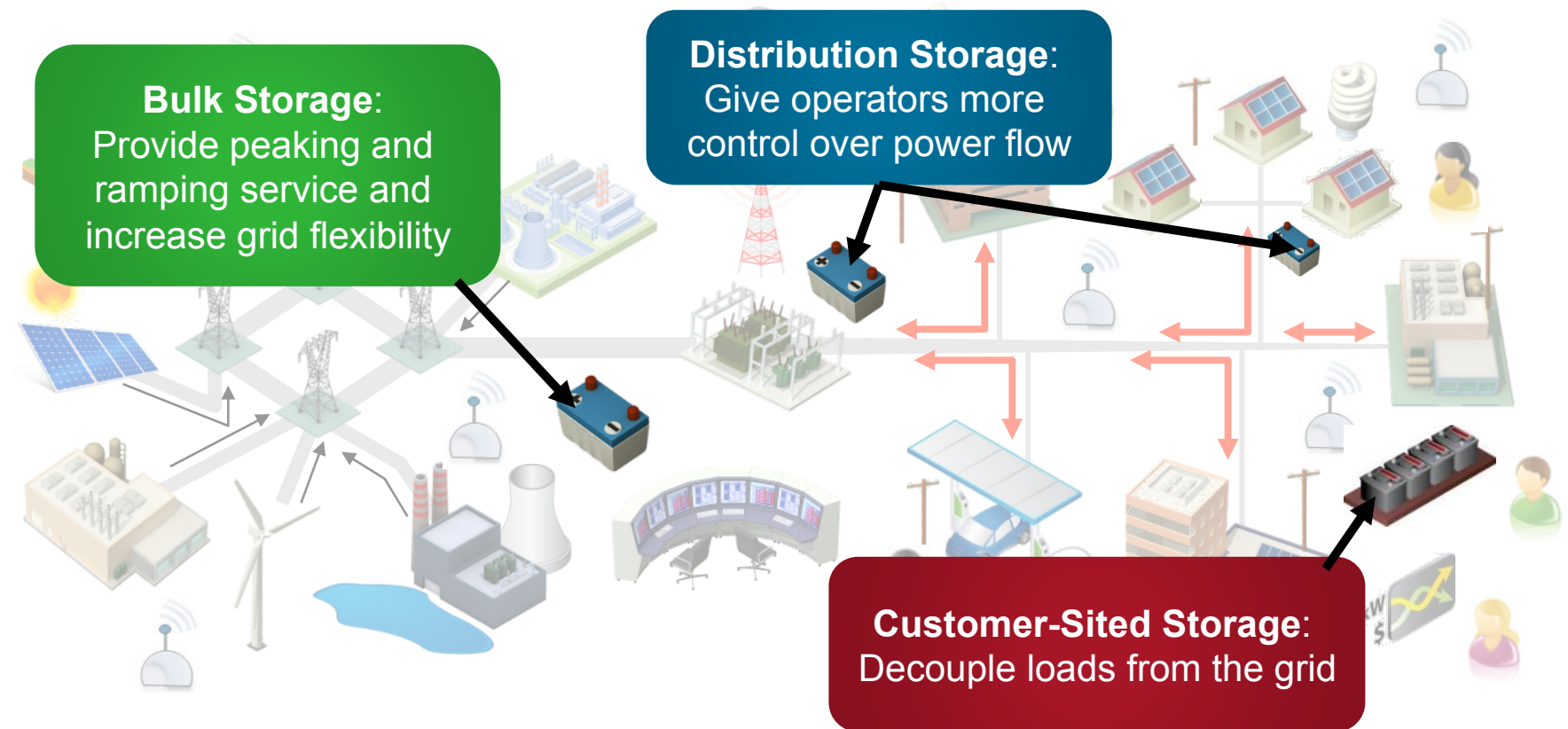


Tomorrow's Power System



**A Highly Interconnected Power System
that Optimizes Energy Resources**

Tomorrow's Power System



Energy storage can play key roles across the grid

Energy Storage: A Flexible Asset for the Grid

- The grid is a just-in-time supply system, designed to deliver energy as it is produced
- Storage can act as a buffer, making the grid more flexible to accommodate more variable renewable generation
- Storage can provide temporary local power, increasing grid reliability and resiliency
- Storage can improve asset utilization on the grid, reducing the potential for future rate increases

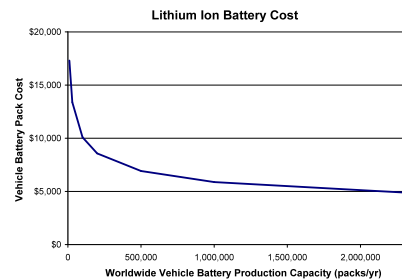


The historical challenges are fading

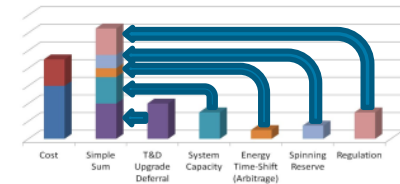
- Technical challenges
 - Performance
 - Life
 - Efficiency
- Economic Challenges
 - High Costs
 - Small Value Streams
- Regulatory Challenges
 - Lack of clear definition
 - Framework designed for existing grid



Advanced Technologies



Lower costs



New Business Models



Regulatory Rulings



Legislative Action

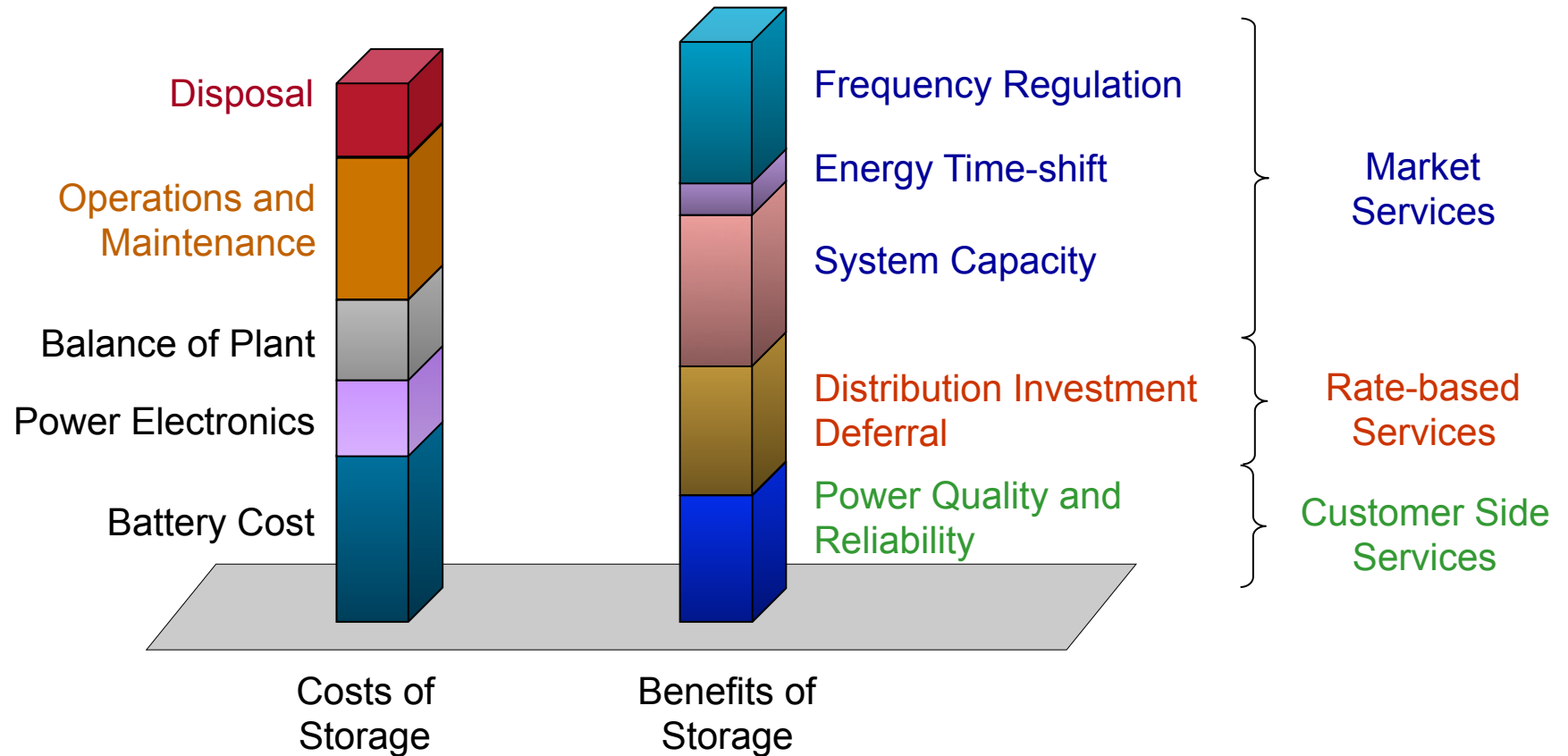
...but many challenges remain

- Costs and performance factors of technology solutions must be better understood
- Tools for understanding the value and grid impacts of storage are still in development
- Grid-ready technology solutions are the exception, not the rule
- Deployment, integration, operations, maintenance, and disposal are still major unknowns
- Deployment of storage technology can be better integrated into utility planning and operations processes to improve reliability and reduce costs



Analyzing the Value of Storage

For Illustration Only

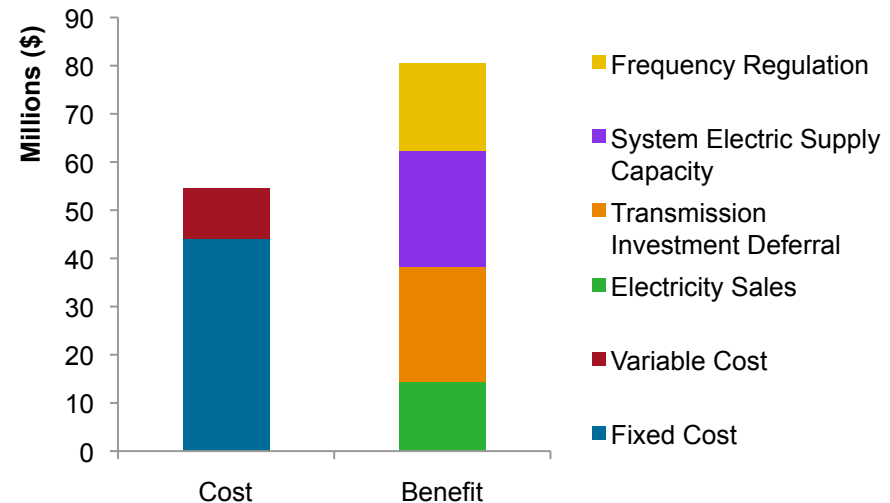


Developing a business case usually requires stacking multiple benefits

Developing analysis tools

- Publicly available tools and methods to **fairly, transparently, and consistently estimate** the benefits and costs of energy storage projects across all cases
 - Grid Services
 - Technologies and Sizes
 - Locations

- Ability to identify and characterize **high value locations** to deploy energy storage, so that early successes in energy storage maximize value to all stakeholders



Energy Storage Valuation Tool 4.0

1. Select Storage Technology Performance and Costs

Energy Storage System: Discharge Dur... (Hours): Define Custom System

System Capital Costs (\$): Discharge Capacity (kW):

2. Select Grid Services for Analysis

3. Select Energy Prices

Energy Price Selection, Early Year:

Energy Price Selection, Late Year:

4. Select Financial and Economic Assumptions

Ownership Type: Discount Rate:

5. View Results

NPV Cost vs. Benefit: Daily Revenue (\$):

Annual Services Revenue (\$): Daily Dispatch (kWh):

Dispatch and Optimization Options

Dispatch Type:

Enable Optimization:

Spreadsheet Import and Export

Case run status:

Extras

Developed by:

Energy Storage Valuation Tool 4.0

An Opportunity: Publicly Available Energy Storage Valuation Software funded by California Energy Commission

■ What is it?

- Cloud-Hosted Energy Storage Valuation Software
- Customized for California Needs
- Available in 2016



■ Goals

- A software platform for **transparent, validated estimation** of energy storage project benefits and cost
- Include **all CPUC use cases and storage technologies** under consideration
- Achieve broad stakeholder buy-in on approach and support highest value uses





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